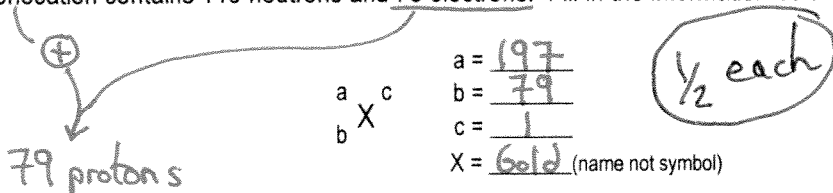


Chem 121 Midterm 1

Sept 28, 2012

Show all work for full marks (sig. figs.) unless otherwise stated.

- (2) 1) A monocation contains 118 neutrons and 78 electrons. Fill in the information below. No work need be shown.

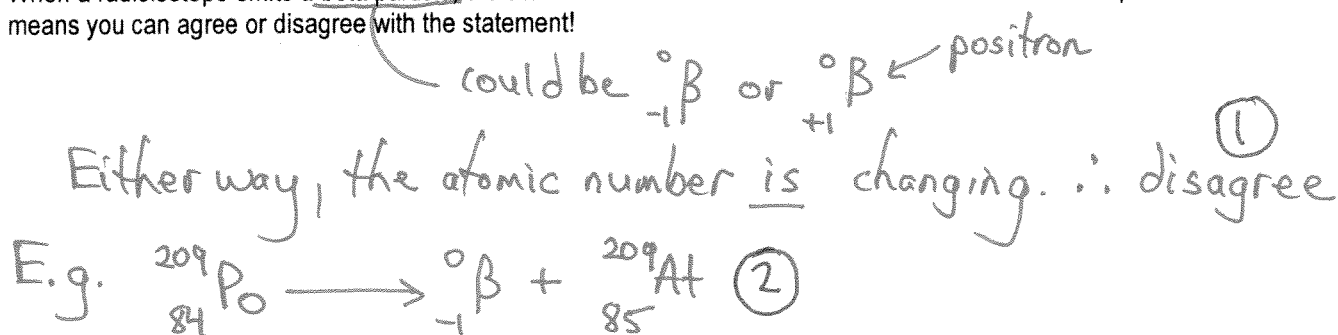


- (3) 2) The latest measurements estimate ^{14}C to be 0.000000001% abundant and therefore we shall neglect its effects. The atomic mass of ^{13}C = 13.003354 amu and the periodic table says the atomic mass of carbon = 12.01115 amu. Calculate the % abundance of the ^{12}C and ^{13}C isotopes.

Let x = abundance of ^{13}C ①. $1-x$ = abundance of ^{12}C .

$$x(13.003354 \text{ amu}) + (1-x)(12) = 12.01115 \text{ amu} \text{ ①}$$
$$x = .0111 = \boxed{\begin{matrix} 1.111\% \text{ } ^{13}\text{C} \\ 98.89\% \text{ } ^{12}\text{C} \end{matrix}} \text{ ①}$$

- (3) 3) When a radioisotope emits a beta particle, the atomic number remains the same. Discuss with an example. Discuss means you can agree or disagree with the statement!



- (4) 4) Complete the following with the correct name or formula. ① each

Cobalt (II) acetate = $\text{Co}(\text{CH}_3\text{COO})_2$

Beryllium hypobromite = $\text{Be}(\text{OBr})_2$

N_3C_3 = Tricarbon trinitride
or
carbon nitride

H_2CO_3 (aq.) = Hydrocarbonic acid

- (4) 5) Calculate the molarity of Na^+ if 35.0 mL of 0.250 M sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3(\text{aq.})$) is mixed with 80.0 mL of 0.420 M sodium pyrophosphate ($\text{Na}_4\text{P}_2\text{O}_7(\text{aq.})$). Everything is completely soluble in water.

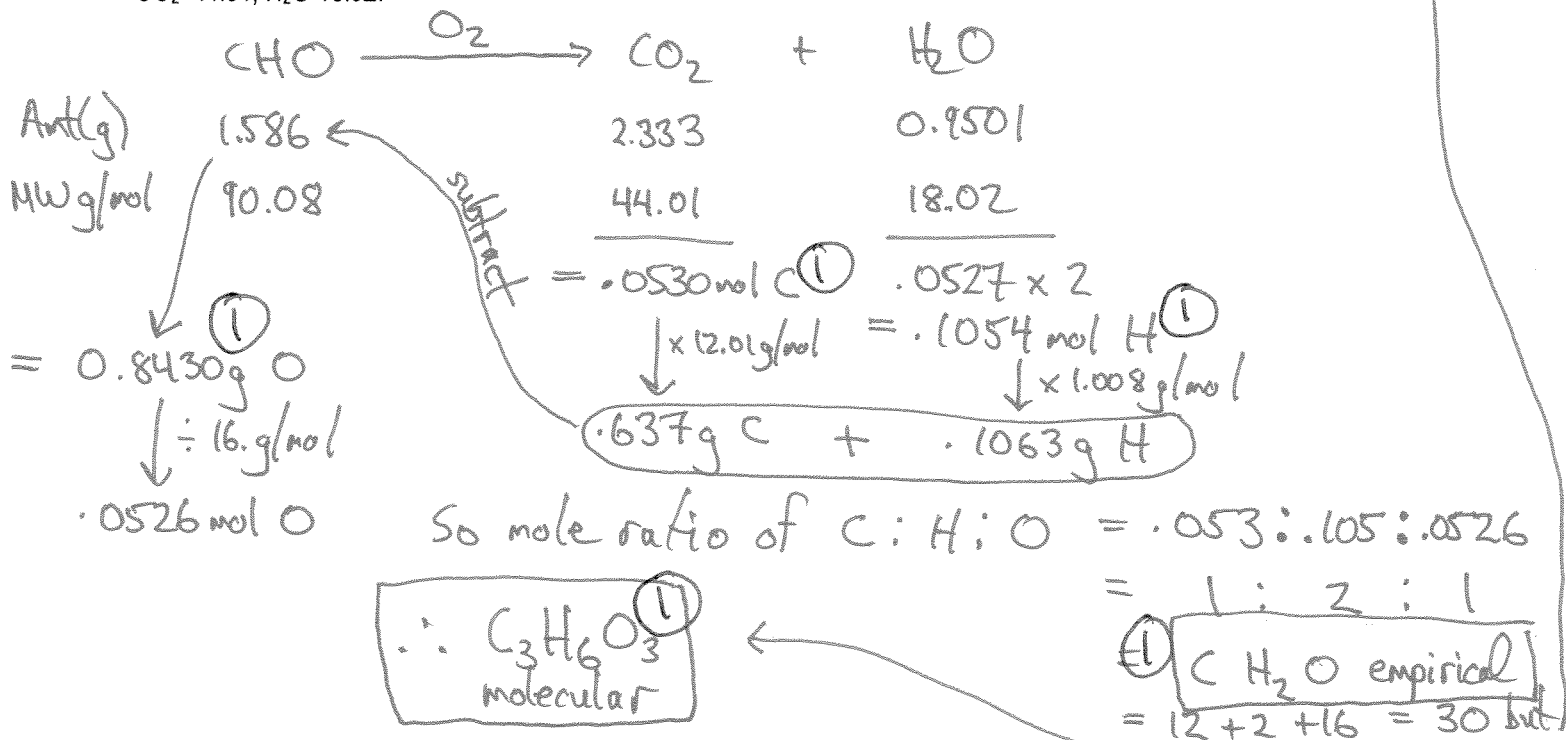
$$.035\text{L} \times \frac{.250\text{mol}}{\text{L}} \text{Na}_2\text{S}_2\text{O}_3 \times \frac{2\text{Na}^{\oplus}}{\text{Na}_2\text{S}_2\text{O}_3} = 0.0175\text{mol Na}^{\oplus} \text{ (1)}$$

$$.080\text{L} \times \frac{.420\text{mol}}{\text{L}} \text{Na}_4\text{P}_2\text{O}_7 \times \frac{4\text{Na}^{\oplus}}{\text{Na}_4\text{P}_2\text{O}_7} = .1344 \text{ " " (1)}$$

$$\frac{.1519\text{mol Na}^{\oplus}}{.115\text{L}} = 1.3209\text{M}$$

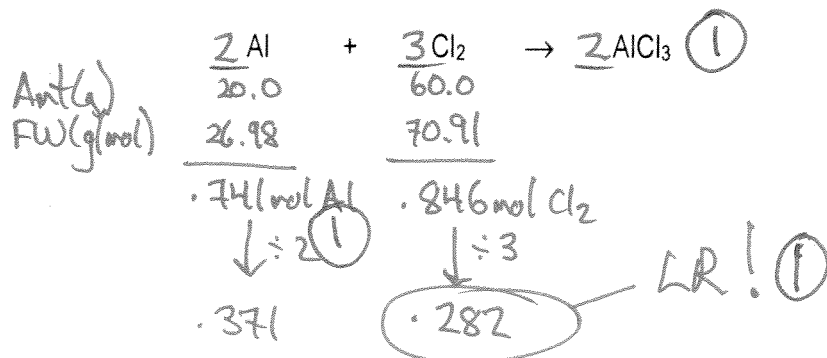
(1) 1.32M

- (5) 6) A 1.586 g of a compound, containing only carbon, hydrogen and oxygen, is burned completely in excess O_2 to produce 2.333 g of CO_2 and 0.9501 g of H_2O . The molecular mass as determined by mass spectrometry is 90.08 g mol^{-1} . What are the empirical and molecular formulas of the compound? Data (g mol^{-1}): C 12.01; H 1.008; O 16.00; CO_2 44.01; H_2O 18.02.



7) Aluminum chloride can be prepared by reacting aluminum with chlorine.

- (3) a) What mass of aluminum chloride can be formed from 20.0 g of aluminum and 60.0 g of chlorine? Indicate the limiting reactant and how you arrived at this conclusion. Data (g mol^{-1}): Al 26.98; Cl_2 70.91; AlCl_3 133.34.



(2) b) What mass of the reagent in excess will remain unused?

$$.846 \text{ mol Cl}_2 \times \frac{2\text{Al}}{3\text{Cl}_2} = .564 \text{ mol Al needed} \text{ but we have } .741 \text{ mol Al}$$

$$= .177 \text{ mol Al in excess (} \times 26.98 \text{ g/mol)}$$

$$= 4.7807 \text{ g Al}$$

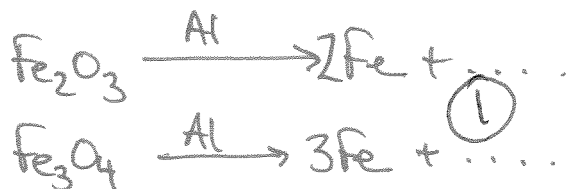
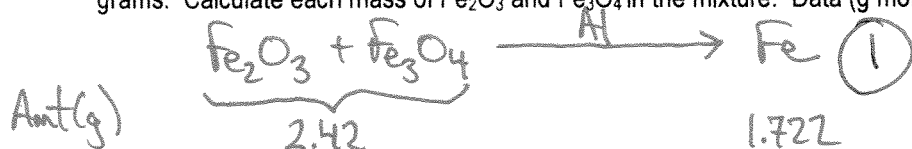
$$= 4.78 \text{ g}$$

(2) c) If 25.6 g of product were obtained when this reaction was run, what was the percent yield?

$$.846 \text{ mol Cl}_2 \times \frac{2\text{AlCl}_3}{3\text{Cl}_2} \times \frac{133.34 \text{ g}}{\text{mol}} = 75.216 \text{ g AlCl}_3 \text{ theoretical}$$

$$\frac{25.6 \text{ g}}{75.216 \text{ g}} \times 100 = 34.0\%$$

(5) 8) A mixture of iron oxides, Fe_2O_3 and Fe_3O_4 , weighs 2.42 grams. The iron oxide mixture is reduced with aluminum to exothermically yield molten iron (plus other unimportant products) in a thermite reaction. The iron weighed 1.722 grams. Calculate each mass of Fe_2O_3 and Fe_3O_4 in the mixture. Data (g mol⁻¹): Fe_2O_3 159.69; Fe_3O_4 231.54.



Let $x = \text{g Fe}_2\text{O}_3$

$\therefore 2.42 - x = \text{g Fe}_3\text{O}_4$

$$\left(\frac{x}{159.69}\right) \left(\frac{2}{1}\right) (55.85) + \left(\frac{2.42 - x}{231.54}\right) \left(\frac{3}{1}\right) (55.85) = 1.722$$

$$25,863.02x + (2.42 - x)(26,756.06) = 63,670.30$$

$$-893.04x = -1,079.36$$

$$x = 1.2086$$

So looks like 1.21g each

Chem 121!